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THE INFLUENZA PNEUMONIA PANDEMIC IN THE AMERICAN ARMY CAMPS DURING SEPTEMBER AND OCTOBER, 1918[1]

THE pandemic of influenza which has been prevalent in Europe and which swept over the United States in the spring of 1918, causing much suffering and disability in industrial plants and loss of training time in American army camps, reappeared with greatly intensified violence in September and October. Within a month of its recognition it had been reported from nearly every quarter of the United States, civil and military.

The army and navy camps suffered severely from the outset. Rarely before in the history of war has infection exhibited a more explosive character or has so large a proportion of troops been infected in camps under conditions of abundant shelter and food and freedom from the strains and anxieties of conflict. The epidemic has been attended by an unusual fatality.

The data and deductions contained in this report are such as are warranted by daily telegrams and other sources of information collected during the course of the pandemic. The final and complete statistics will not be available until after the outbreak is completely over.

During the period September 12–October 18, 1918, inclusive, there were 274,745 cases of influenza reported among the troops in America. During the same period there were 46,286 cases of pneumonia and 14,616 deaths.

The incidence of influenza and pneumonia among all troops in the United States, week by week, from the outbreak to and including October 18, 1918, follows:

[1] Published by permission of the Surgeon General of the U. S. Army.

CASES OF INFLUENZA AND PNEUMONIA AND DEATHS EACH WEEK AMONG ALL TROOPS IN THE UNITED STATES FOR THE PERIOD, SEPTEMBER 12–OCTOBER 18, 1918

	September		October			Total
	20	27	4	11	18	
Influenza ..	10,094	37,493	88,478	90,393	48,287	274,745
Pneumonia.	758	4,313	8,655	17,882	14,768	46,286
Deaths	96	951	2,275	6,005	5,289	14,616

The foregoing table indicates that the pandemic claimed the greatest number of victims in the week ended October 11; this was four weeks after the first local outbreak was discovered. In this week, roughly one third of all the cases of influenza and pneumonia and deaths occurred.

THE OUTBREAK OF THE PANDEMIC

The first report that a serious epidemic existed in any camp came from Devens, at Ayer, Mass. On September 16 the camp sanitary inspector, reporting through the camp surgeon to the Surgeon General of the Army, announced that an epidemic of so-called "Spanish influenza" had broken out at Devens as a part of a general epidemic which had attacked Boston and the neighboring states and towns some weeks before.

The Devens epidemic is supposed to have commenced on September 7, 1918, in D Company, 42d Infantry. On that date a case of supposed meningitis was sent to hospital from this company; on the following day twelve cases were sent for observation. These proved to be influenza. By the sixteenth 37 cases had gone from the same company. One death from pneumonia had occurred. Almost simultaneously, other cases appeared in other organizations. By September 12 the total number of cases which had been admitted was 599. The disease spread rapidly, in spite of the measures taken to check it. On September 20 the epidemic reached its maximum intensity. On that day 1,543 new cases were reported as having been admitted to sick report. After reaching this high point the number of new cases rapidly became less, so that by the end of the month there were less than 100 new cases reported per day.

Meanwhile, pneumonia had become a frequent and fatal accompaniment of the influenza at Devens. Fifty new cases were reported September 19, less than three weeks after the influenza had broken out. The number rapidly increased; on September 24, there were 342 new cases. The number each day remained at about 200 for four days; then there was a decrease, until, before the end of the month, 40 per day had been reached. Since October 4 there have been less than five new cases daily.

The Devens outbreak, so far as may be understood from the records at hand, could be divided into 4 parts as shown in the following table:

THE RISE AND FALL OF THE INFLUENZA-PNEUMONIA EPIDEMIC AT CAMP DEVENS, AYER, MASSACHUSETTS, 1918

	Duration Days	Cases Infl.	Cases Pneu.	Deaths
Rise (Sept. 12–19)	8	3,283	43	16
Peak (Sept. 20–21).....	2	2,722	205	43
Rapid decline (Sept. 22–29) ..	8	3,141	1,495	298
Slow decline (Sept. 30–Oct. 18)	19	571	571	310

It will be observed from the foregoing table that the rise of the epidemic covered a period of about 8 days; the peak 2 days; the rapid decline 8 days, and the slow decline 19 days. Half the deaths and nearly three quarters of the pneumonia occurred during the period of rapid decline or within less than three weeks of the outbreak.

CHARACTERISTICS OF THE DEVENS EPIDEMIC

The characteristics of the Devens epidemic have been described here because they represent what has occurred at many camps. The earliest cases have often escaped identification. They may be taken for cases of food poisoning, meningitis, or one of the common exanthemata. The disease which is epidemic bears little resemblance to the coryzas and other respiratory

affections to which the term influenza has been generally applied for the last twenty years.

The leading symptoms in the typical cases are: severe headache; chills or chiliness; pains in the back and legs; temperature sometimes as high as 104; great prostration; drowsiness. Occasionally there are nervous symptoms; sometimes, but not always, the eyes and the air passages of the nose and throat are affected; there may be gastro-intestinal disturbances. The onset is sudden. The patient can often tell the exact moment of his attack. In the typical case he is very sick—wholly incapacitated for exertion. He lies curled up and can hardly be roused for food. In two or three days the fever usually disappears by crisis and the patient feels that he is rapidly recovering. It is highly important that he be well cared for and kept comfortably warm during the next week. Pneumonia occurs in about 18 per cent. of the cases; it proves fatal in over one third of those attacked.

The fact that an epidemic existed in a camp has generally been recognized when the number of new cases has amounted to 100 or more per day. The incidence then increases rapidly. Sometimes the records show a great number of cases at the start, and there are marked fluctuations in the daily incidence as the epidemic continues. Striking irregularities do not represent the way in which the disease occurs but are to be accounted for by the stress and difficulty with which the returns are collected. The greatest number of new cases reported for any day has often considerably exceeded 1,500 in a camp. At Devens the maximum was 1,543. At Grant, 1,810 and Custer, 2,800. The high point has often been reached on about the tenth day of the epidemic.

Epidemics commonly subside almost as rapidly as they arise. Within from 16 to 20 days after the outbreak the number of new cases per day falls to 200 or less, after which there is a more gradual decline to the end. In its epidemic aspect, as in the individual case, the disease is characterized by sudden onset, great intensity, and rapid recovery.

Within about a week after the outbreak of the influenza there occurs an ominous prevalence of pneumonia. The pneumonia does not exist as a separate epidemic, but is always a follower of the influenza. How the two diseases are related is not positively known. It is clear that the influenza paves the way for the pneumonia, if it does not actually produce it. Most of the pneumonia is of the lobular type and presents various unusual aspects. The time of greatest incidence is usually about a week after the greatest incidence of influenza.

SPREAD OF THE PANDEMIC

The second camp to report an epidemic following Devens, was Upton, on Long Island, N. Y.; the third was Lee, in Virginia. Dix, in New Jersey, and Jackson, in South Carolina, followed immediately. Hoboken, N. J., Syracuse, N. Y., Gordon, in Georgia and Humphreys, in Virginia, all reported on the same day. Within a week from the start, nine large camps in widely separated parts of the country were attacked. Others followed in rapid succession. The table on the following page gives the order in which the camps were attacked. In addition there were many epidemics reported from posts, aviation stations and other troop centers.

THE OUTLOOK FOR THE FUTURE

How far the pandemic will spread will apparently depend only upon the material which it can feed upon. It is too early to foretell the end or to measure the damage which will be done before the pandemic disappears. Enough is known to show that hereafter influenza is not to be ranked merely as an endemic disease of civil life, but an infection of first-class military possibilities. It is not improbable that the present pandemic may disappear as rapidly as it came, although most persons hold the opinion that its final disappearance will be gradual, the extinction of the disease being postponed for many months. In the pandemics which sweep over the earth at long intervals, recurring waves of the disease in greater or less degree commonly occur. If this rule holds

Order	Camp	Location	Date
1	Devens	Massachusetts	Sept. 12
2	Upton	New York	" 13
3	Lee	Virginia	" 17
4	Dix	New Jersey	" 18
4	Jackson	South Carolina	" 18
5	Hoboken	New Jersey	" 19
5	Syracuse	New York	" 19
5	Gordon	Georgia	" 19
5	Humphreys	Virginia	" 19
6	Logan	Texas	" 20
6	Funston	Kansas	" 20
6	Meade	Maryland	" 20
7	Grant	Illinois	" 22
7	Taylor	Kentucky	" 22
8	Sevier	South Carolina	" 23
8	Lewis	Washington	" 23
8	Newport News	Virginia	" 23
9	Pike	Arkansas	" 24
10	Beuregard	Louisana	" 25
10	Eustis	Virginia	" 25
11	Greene	North Carolina	" 26
11	McClellan	Alabama	" 26
12	Kearney	California	" 27
12	Bowie	Texas	" 27
13	Johnston	Florida	" 28
13	Sheridan	Alabama	" 28
14	Sherman	Ohio	" 29
14	Dodge	Iowa	" 29
14	Shelby	Mississippi	" 29
15	Custer	Michigan	" 30
16	Travis	Texas	Oct. 1
17	Cody	New Mexico	" 3
18	Forrest	Georgia	" 6
19	MacArthur	Texas	" 7
20	Wadsworth	South Carolina	" 11
20	Wheeler	Georgia	" 11
20	Greenleaf	Georgia	" 11

true now we may look forward to another pandemic before many months are past. It is to be remembered that the present is the second, not the first, great wave which has occurred here this year.

The pandemic now raging may truly be termed an epidemic of epidemics. However desirable it may be to ferret out the cause to the first case this can not be done. Like all great outbreaks of this most infectious of communicable diseases, the epidemics now occurring appear with electric suddenness, and, acting like powerful, uncontrolled currents, produce violent and eccentric effects. The disease never spreads slowly and insidiously. Wherever it occurs its presence is startling. The consternation and alarm which it produces frequently lead to irrational and futile measures to check it.

In theory and practise influenza is preventable but it is very difficult to control under municipal and military conditions. It rarely happens that the necessary measures—chiefly isolation—are taken in time. In the present pandemic the disease has, on more than one occasion, been confined to certain wards of hospitals to the exclusion of others. It is not possible as yet to state to what extent it has been restricted in camps. No large camp has escaped it.

The following table gives the numbers attacked and the deaths recorded up to October 18 in twenty of the largest camps and cantonments:

TABLE OF CASES AND DEATHS AMONG 20 CAMPS GROUPED IN THEIR CHRONOLOGICAL ORDER OF ATTACK

	Total Cases Influenza	Total Cases Pneumonia	Total Deaths Pneumonia	Per Cent. Attacked Influenza	Per Cent. Pneumonia to Influenza	Per Cent. Deaths Pneumonia
Five camps attacked (Sept. 12–18)[2]	45,789	7,671	2,861	20.6	16.7	37.3
Five camps attacked (Sept. 22–24)[3]	42,267	7,399	2,591	21.2	17.3	35.
Five camps attacked (Sept. 29–Oct. 1)[4]	32,932	6,818	2,280	21.8	20.7	33.6
Five camps attacked (Oct. 3–11)[5]	17,307	1,236	210	22.8	7.1	17.8

As the pandemic has progressed the proportion of soldiers attacked has increased, and the proportion developing pneumonia has increased while the fatality of the pneumonia has diminished. These differences have been slight, but they seem to be unmistakable. If these figures are fully substantiated by later

[2] Devens, Upton, Lee, Dix, Jackson.

[3] Grant, Taylor, Sevier, Pike, Newport News.

[4] Sherman, Dodge, Shelby, Custer, Travis.

[5] Cody, Forrest, MacArthur, Wadsworth, Greenleaf.

and more complete returns, the facts and inferences to be drawn from them will be of great moment.

The disease is carried from place to place by persons, not things or by the general atmosphere, as was once supposed. Its rapidity of spread is due to its great infectivity, short period of incubation, missed cases and absence of timely precautionary measures. It would appear that an epidemic does not easily start, but once the flame is well kindled a conflagration occurs which can not be stopped. The epidemics stop themselves. This they do either by the exhaustion of the susceptible material, by a reduction in the virulence of the causative agent, or both.

The causative agent is believed to be the bacillus of Pfeiffer; the means of transfer; the air and objects recently contaminated by the buccal and nasal secretions of those who harbor the virus. It is a fundamental assumption that influenza is produced when, and only when, material from the mouth or nose of infected persons gets into the mouth or nose of someone who is susceptible. As is plainly recognized in respect to intestinal infections, the hand probably plays an important part in the transmission of influenza. Coughing and sneezing help greatly to spread infection.

CHANGES IN VIRULENCE

It has long been known that interchanges of bacteria occur commonly from mouth to mouth under ordinary conditions of social intercourse. Most of the organisms are harmless under normal conditions of health. That their virulence is sometimes increased, sometimes reduced, according to circumstances, appears to be certain. But what the circumstances are which raise or lower the virulence is conjectural. The Pfeiffer bacillus is no stranger to America; it was believed to be present in many healthy persons before the present pandemic. To account for the pandemic it has been suggested that something must have happened to increase its virulence or a new and more active strain has appeared, or the susceptibility of those attacked has become greater.

The conditions which govern susceptibility are not understood. Good general health, absence of fatigue and avoidance of cold and hunger are standard methods of prevention for the individual. Vaccination against pneumonia is practicable but such preventive treatment is in the experimental stage as respects influenza.

The belief that immunity is conferred by an attack is partly confirmed by the observation that in Europe and America a preponderance of persons who have suffered in the present pandemic are relatively young persons, few of whom could have experienced the disease during the pandemic of 1889–90.

The weather has always been supposed to exert an influence upon influenza—the very name is derived from the effect which extraterrestrial conditions were supposed to exert upon it. But although there has been a great deal of study of this subtle matter, little is known concerning it. It seems probable that the weather this fall has aggravated the disease and contributed to the incidence of pneumonia.

The epidemics which occurred in the spring of 1918 were like those which are taking place now, except that the disease was milder and there was less pneumonia. Until recently the influenza reported from Europe was of this mild type. It seems to have been as infectious as it is now. Reports coming from all parts of Europe indicate that the percentage of persons attacked was about the same at that at present.

Something seems to have occurred during the summer greatly to increase the virulence of the disease. During July and August a number of vessels plying between Europe and America experienced intense outbreaks of influenza, accompanied by very fatal pneumonia. That cases of the disease were being brought into the country in this manner was stated in the daily press and in official reports in July.

COMPARISON WITH OTHER PANDEMICS

It is interesting to compare the present pandemic with others, but it is impossible to say

how severe were some of those which are recorded in history for the reason that statistical data concerning them is meager and imperfect. It is said that in 1889–90 no less than 25 per cent. of the population was attacked in London; 33 in Antwerp; 39 in Massachusetts, and in Paris, 50. In 1832–33 about 40 per cent. of the population of Paris is believed to have been affected. In 1872, three quarters of the population of London and some German cities were supposed to have suffered. The records of earlier visitation are more obscure.

Many observers of pandemics in other years have pointed out that influenza is a more fatal disease than is commonly understood, the fatality being due chiefly to lung and heart complications which do not promptly manifest themselves. Thus, although the number of deaths directly attributed to influenza in England and Wales in 1890 was reported as 4,523 per million, the Registrar General, by analysis of the vital statistics for the period, stated that the number of deaths directly or indirectly attributable was 27,074 per million, or nearly seven times the apparent rate. In London the general death rate was increased by over 20 per cent., in Berlin by more than 60 per cent. and in Paris and Brussels by over 100 per cent. No records now available show that there has ever been so much fatal pneumonia as in the present pandemic

The total number of cases of influenza in the present outbreak, inside and outside of the army camps, will never be accurately known. Although it is beyond doubt that the disease which is prevalent in the camps is the same as that which is widely distributed in civil life, it is not to be assumed that all the cases which occur are officially reported or that every case which is supposed to be influenza is really that disease. At this season of year there are always epidemics of colds and other respiratory infections. The weather this year has been particularly favorable to their occurrence. Under the present conditions of public anxiety, it is but natural that all cases of illness which at all resemble influenza should receive that designation. The net result of all the factors which enter into the matter is confusion. The army records have been systematically tabulated and studied from the first. When the pandemic has subsided the information to be derived from these data should be of much permanent value.

George A. Soper
Major, Sanitary Corps, U. S. A.,
October 26, 1918

BRITISH SCIENCE IN INDUSTRY[1]

After years of what appeared to be fruitless discussion of the relations between industry and science and an annual crop of proposals as to the means whereby these relations might be improved, it would seem that a beginning is being made with the garnering of the harvest. We have not altogether perhaps lost our old habit of carrying out the pioneer work in the scientific field and leaving to others the commercial tillage; but the shock of war has modified the attitude of the devotee of pure science to industrial problems, and the manufacturer has had proof that the head of the research worker is not always in the clouds. Both parties are learning to respect each other, and the result is proving a national benefit. Some of the directions in which the gain has been made are revealed in the exhibition organized by the British Science Guild which is now being held at King's College.

INITIAL DIFFICULTIES

It need hardly be stated that the difficulties which stood in the way of the organizers were by no means insignificant. Not only had the sanction of the Ministry of Munitions and the Board of Trade to be obtained, but as the usual charge for space has not been made to exhibitors it has been necessary to meet the cost mainly by voluntary contributions and the fact that the exhibition is in no sense a trade fair where orders may be obtained has limited the display to those who were actuated by a sense of public spirit rather than any hope of pecuniary gain. The scope of the exhibition, which it was desired to make representative of industrial development since the war be-

[1] From the London *Times*.

gan, has also been dwarfed by the circumstance that so large a percentage of our manufacturing activities has been concerned with war work which it would not be expedient to display to public view. There has been a restriction of the exhibits from other causes, of which the pressure on manufacturers for delivery to the fighting services has been the most important. It is a tribute to those responsible for what has been done that in the face of these restrictive influences they have found it possible to secure the cooperation of manufacturers and scientific workers concerned with so many different branches of industry as to make an effective display of articles now produced in home workshops and laboratories which before the war were obtained chiefly from enemy countries. The chemical, electrical and mechanical engineering industries, iron and steel and non-ferrous metals trades, scientific instrument manufacture, the textile glass industries, and aviation and road transport, as well as food production and preservation, and surgery and bacteriology, have all been laid under tribute.

The first impression the visitor gains is perhaps one in which confusion occupies the chief place. For the moment it would almost seem as if a collector had been allowed to run riot through a host of products, the uses of which are often as asunder as the poles. This impression passes, and the exhibition is seen in its right perspective—not as an ordered sequence of manufacturing processes, but as illustrating the latent capacities of some of our scientific industries, the proper development of which has in the past been throttled partly by the stress of subsidized competition, partly by indifference and lack of application of science to the solution of industrial problems. The numerous sections into which the exhibition is divided are so many milestones on the roads of progress that lead in various directions towards the goal of increased national efficiency.

METALLURGY

The section which is devoted to ferrous metallurgy illustrates the character of the task which has been undertaken during the war. It is now a familiar story how the cutting off of supplies from enemy sources of certain materials essential to the steel trade embarrassed this great industry. The supply of refractory materials not only for the constantly expanding steel trade, but for other key industries had somehow to be maintained Accounts have been given in the *Engineering Supplement* of the fine work done in exploiting our own sources of supply of coke-oven and furnace bricks for various requirements, and the exhibits in this class indicate the success which has been won in the organization of a branch of British trade which has hitherto lacked the stimulus of national effort. It is also the case that the increased applications of the electric furnace in steel manufacture make it more than ever necessary to invoke the aid of exact scientific investigation in the evolution of refractories to withstand the higher temperatures which are coming into use.

What has happened in connection with refractory materials has been repeated in the case of tungsten, an essential constituent of many special steels. Engineers are aware with what energy, on the initiative of Sheffield manufacturers, this subject was attacked and British firms put in a position to produce a range of compounds and metallurgical products for which they previously relied on Germany, notwithstanding the fact that there are ample supplies of the necessary raw materials within the confines of the Empire. Reference is made above to the developments in electric furnace practise, and the section of the exhibition devoted to ferrous metallurgy contains various examples of recent advances. A somewhat striking exhibit illustrates new methods of producing sound steel.

LIGHT ALLOYS

The outstanding advance in non-ferrous metallurgy to which witness is borne at King's College has been in the production of light alloys, the principal application of which has been in the construction of aircraft. This has called for an increased output, not

merely of aluminium, the basis of many light alloys, but also of magnesium, which is now being manufactured on a considerable scale in Great Britain. The production of electrolytic zinc, an increase in the output of copper alloys, the introduction of metals in the powdered form, a considerable extension of die-casting methods, and a general marked improvement in technical practise are other directions in which this little exhibition gives ground for satisfaction in the character of our industrial awakening.

AIRCRAFT AND ROAD MOTORS

One section of the exhibition shows what has been done by the alliance of science and industry to secure that supremacy in the air which is essential to success in modern warfare. The principles which govern design, materials of construction, trend of development in aircraft engines, the use of parachutes to enable airmen to make a safe descent from a damaged machine, the utilization of women workers in aircraft factories—all these things are either illustrated or suggested.

Another group of exhibits illustrates what has been done by the Gas Traction Committee to promote the employment of gas in substitution for petroleum products as a source of power for motor vehicles, and a completely fitted road transport vehicle shows the high pressure equipment which has been approved by the committee for the purpose of an experiment on a commercial scale with 20 motor-omnibuses in London service.

ELECTRICAL APPARATUS

In the electrical section the display is a little disappointing, but the progress in this and other departments of manufacture which have called for the assistance of research workers is indicated, where the exhibits fail to show it, by the excellent series of special articles which form the first section of the official catalogue. Two outstanding developments are, however, the subject of exhibits in the electrical group. One of them shows what has been done to establish a British magneto industry, with the result that during the past four years 300,000 magnetos have been manufactured for war service alone. The measure of this achievement is expanded by the claim which can be justly made that the British magneto is as good as that for which German manufacturer previously held a monopoly. The other exhibit illustrates the progress of electric welding.

The display of scientific instruments is also somewhat meagre, but it has been difficult for maunfacturers to withhold deliveries which were in urgent demand, and the exhibition has been robbed to serve the needs of the country. Much progress has, however, been made in original design, and the output during the war to meet the requirements of the Admiralty, the Ministry of Munitions, and the Air Board has been remarkable. The exhibits sent by the National Physical Laboratory indicate some of the lines of advance, a particular example being the mirror extensometer, a type which was formerly made in Germany. The exhibit from the Teddington establishments shows the character of the experimental work which is now being carried on in the gauge rectifying shop with the object of speeding up the manufacturing process and of obtaining an increased degree of accuracy.

CHEMICAL INDUSTRY

If the special work which has been undertaken on behalf of the engineering trades has been selected for attention here, it is not because equally good results have not been obtained in other industries, but because the situation in engineering was essentially typical of that which existed at the outbreak of war. Nothing which has been accomplished during the past four years is of greater importance than the work in connection with chemical products and processes. The grave deficiencies in the supply of the materials for the production of explosives, dyes and drugs, and the lack of trained chemists to supervise manufacturing processes, have been largely overcome, while experimental work in connection with the supply of intermediate prod-

ucts for the production of dyes—hitherto a great German monopoly—has met with very gratifying success. Quite apart from what has been done by the powerful interests represented by British Dyes (Limited) and its allies, specimens are shown by the Chemical Research Laboratory of the University of St. Andrews of twenty-five fine chemicals previously obtained from enemy sources, most of which are now prepared on the manufacturing scale by processes developed in the laboratory during the past three years and a half.

TEXTILES AND GLASS

Mention must also be made of the extraordinary development of the textile industries. As the exhibits sent by the Bradford Technical College and the Nottingham Chamber of Commerce demonstrate, a considerable advance has been made in the production of worsted goods and of cotton embroideries which were previously almost exclusively imported from Germany. It is recognized that the production of knitting needles is one of the key industries necessary to make Great Britain self-supporting, and a great effort has been made to increase the British output of latch needles, in which before the war Germany held 90 per cent. of the world's trade. Nor is it inappropriate, in view of the use of King's College for the exhibition, to refer to the work which has been done by Sir Herbert Jackson, the professor of chemistry in the college, to provide the chemical and optical glass urgently needed when supplies from Germany and Austria were cut off. The pure potash required for certain glasses is now obtained by a new electrolytic process, and the net result of this and much other work has been the reawakening of the glass industry and the attainment of a position which it is believed is strong enough to enable our manufacturers to meet all assaults upon them.

DOCTOR ALEŠ HRDLIČKA AND THE VERO MAN

IN Bulletin No. 66 of the Bureau of American Ethnology there has recently appeared Dr. Aleš Hrdlička's long-awaited report on the human remains found at Vero, Florida. The delay in printing this document has resulted in giving to it some of the flavor of ancient history. In compensation, however, there are introduced certain original ideas in dynamic geology, some of which will be considered below. Unfortunately there is no adequate treatment of that 160-foot geological section which, we were assured,[1] afforded a view at once comprehensive and enlightening.

The writer does not intend to debate the question whether the geologists and the paleontologists ought to have anything to say in such an important matter as that presented at Vero. It is preferred to introduce two expressions of opinion that ought to have a degree of weight. It happens that both of these were called forth by discoveries made some years ago at Trenton, N. J. Professor W. H. Holmes[2] wrote:

> Little by little the advocates of a paleolithic culture in America have been forced to give up the idea that there is any other reliable test of the age of a culture than that furnished by geology.

Dr. Aleš Hrdlička[3] was engaged in studying a fragment of a human femur and a piece of parietal. Not having gained any results from the comparison with corresponding bones from Florida and Mexico, having regard especially to their chalkiness and their tints of yellow, he delivered the following opinion:

> The determination of the age of the two bones, however, must be based principally on their location with regard to geological formation.

It is evident that Dr. Hrdlička has changed his opinion since that sentence was penned. Perhaps the geological test has not always resulted to his liking, and he has resolved to base his judgments hereafter on the state of development of the skeleton, as determined by European standards. Now he tells us[4] that the age of the strata and the determination and age of the animal remains in them are matters quite irrelevant to the discussion of

[1] "Symposium," p. 43.
[2] SCIENCE, Vol. XX., 1892, p. 297.
[3] "Papers Peabody Mus.," Vol. V., p. 247.
[4] Bull. 66, p. 60.

the human bones. Anthropology then, so far as it is represented by Dr. Hrdlička, has issued its declaration of independence. We are now informed that the presence of human bones in a deposit can, without the aid of the geologist and paleontologist, be readily explained so long as the deposits could have been penetrated a few hundred years ago by a man who wanted to bury his dead. Any disturbance of the earth would subsequently soon be obliterated by "adventitious stratification" (p. 49, pl. vii). Had our physical anthropologist reached this belated result while he was studying the Trenton bones he need not have so strongly committed himself to the potency of geology.

The case needs further consideration. Mr. Volk[5] had found the above-mentioned fragment of femur at a depth of 7 feet 6 inches. At the surface were 7 inches of black soil, followed below by 16 to 20 inches of yellowish sand, this by 44 inches of coarse gravel and cobble stones, below which were 21 inches of greenish sand. In the latter lay the bone in question. Some obsessed persons have believed that this discovery proved the presence of man in that region during the Wisconsin glacial stage. How much more reasonable it would be to suppose that a modern Indian, with an antler and his endowment of patience (66, p. 43), dug down through those gravels and sands and buried a corpse there? Naturally by the time the black soil, and the yellow and greenish sands, and the gravel and stones had been returned to the grave they would have been pretty thoroughly mixed together; but anybody by examining Volk's figure can see how nicely the materials had rearranged themselves. Had the bone not been discovered, nobody would ever have suspected that a grave had been dug there. The fact that only a piece of bone was found need not cause any surprise or skepticism; for doubtless "dissociation and fragmentation occurred later owing to movements, stresses, root action, and other agencies operating on or within the deposits enclosing the body" (66, p. 48). Apparently the fragment of parietal was caught in its migrations 20 feet away. Perhaps we get a clue here to the reason why civilized peoples nail up their dead in good strong boxes.

That there may occur movements in rocks and soils is well known. There is recognized even a creep of the continents towards the sea. Science has, however, concerned itself too little with the local movements that, according to our author, may go on in a deposit which is not absolutely solid. Some idea of the extent and complexity of these movements may be secured by studying Dr. Sellard's figure[6] which shows the positions of some of the bones of the scattered skeleton found at Vero. Joining by straight lines the parts of a bone or two bones which normally were in contact with each other, one may see the directions along which the forces may, in their simplest expression, have acted and the results thereof. These lines sometimes make nearly right angles with each other. If the suggested movements really occurred in the sand and muck they were probably still more complex. There must have been something like peristaltic action going on there. One can only wonder that the bones subjected to such translations are now found with the edges of fractures unworn and the surfaces unabraded.

One of the surprising results reached by Dr. Hrdlička is that derived from the study of the skull. He now expresses a good deal of doubt about the kind of Indian that owned the skull, if Indian it was at all. We are told, (66, p. 55), that it might be that of an Algonquian, or a Sioux, or even a cross between an Indian and a white man. On the page cited this last impression had been "definitely removed"; but subsequently (p. 59) we are informed that "there remains some persistent doubt" whether the skull was not that of a white-Indian individual. As the case stands now, we may be permitted to believe that the individual was none of these three varieties, but a plain Pleistocene Indian. Perhaps a renewed and intensive study of the pottery and the flint and bone articles might yield a similar result.

[5] "Papers Peabody Mus.," Vol. V., pp. 113–117, pls. 103–107, text fig. 23.

[6] *Jour. Geol.*, Vol. XXV., p. 12, fig. 4.

The distinguished author whose work is being reviewed has great difficulty (66, pp. 42, 43) in understanding how a human skeleton might have become covered up in a deposit being laid down slowly in water; and he concludes thereupon that the body must have been intentionally buried. In the sand deposit no. 2, Dr. Sellards[7] found a nearly complete skeleton of a large alligator. If now, in Hrdlička's remarks "alligator" be substituted for "human body" and "corpse" we shall be compelled to conclude that the alligator too was a subject of intentional burial.

Various other difficulties are encountered by our author regarding the degrees of aggregation and dispersal of the human bones and their physical and chemical states; but after all has been said, the fact remains that they are in practically the same condition as those of the deer and the great armadillo and the alligator, about which nobody raises any questions.

On his page 37 Dr. Hrdlička undertakes a consideration of the "broader aspects of the case" and he asks whether it was possible for man to be in Florida in Pleistocene times. He himself replies that the presence of man there at that time, or even on the American continent, can not be admitted by anthropology. In doing so, he simply assumes that what is supposed to be known about man in Europe furnishes a standard by which all matters anthropological the world over must be settled. He says that no pottery is known to have existed in the world before the Neolithic age. On the contrary, it has been shown[8] that pottery has been found in this country in the early Pleistocene at Charleston, Vero and Nampa. Did an Indian go out furtively into that swamp at Charleston, dig down 3 feet in the muck, and hide away from his fellows, alongside of the mastodon tusk and horse teeth, that potsherd?

On his page 38 Dr. Hrdlička tells us that if man had reached Florida in the early Pleistocene he must have been represented on our continent by large numbers and that these would have left some traces of their presence, of which he insists there are none. On the contrary, the present writer, as cited above, has shown that there are numerous evidences of man's early presence in America. What Dr. Hrdlička seems really to believe is that men at that time were extremely scarce, so few in number that they could not have reached America. At any rate (66, pp. 36, 49, 50) he thinks that the discovery of a single human skeleton at any place would be a marvel; while the chance of finding another near by and in a different geological formation would be infinitely small. This conception is worthy of application to other cases. Some years ago Mr. J. W. Gidley discovered in a crevice in western Maryland, a jaw of an eland hardly distinguishable from the eland of South Africa. How, now, did that eland jaw get into that fissure, "in a little wild spot of the far-away wide inhospitable" mountains of western Maryland? A great part of the Pleistocene must have been required by the ancestors of this antelope for their "physical differentiation, multiplication in numbers, acclimatization to new environments and spread over the numerous territories of the old world, the warmer parts of which were their cradle" (p. 37). And then they had to occupy the new world as far east and south as Maryland! To do this they must have existed in great numbers; and so they might be expected to have left abundant traces of themselves. No such traces have, however, ever been reported from any other locality. The animals must, therefore, have been scarce indeed. What a marvel it is then that remains of one skeleton should have been met with, especially of a species which probably was not addicted to hiding in crevices; but the miraculous thing is that Gidley found in that same formation, in that same fissure, remains of two individuals! This is more astonishing than would be the finding of a second skeleton near by in an overlying formation; for as the years by thousands passed by the chances would increase that parts of another skeleton would be buried not far away. Our credulity is overpowered. Out with geology and paleontology! How

[7] Eighth Ann. Rep. Fla. Geol. Surv., p. 145.

[8] Hay, *Amer. Anthrop.*, Vol. XX., pp. 15, 16, 25.

much easier, how much more reasonable, it is to suppose that a pair of African elands escaped from some passing show, perhaps from one of P. T. Barnum's incomparable aggregations, and fleeing to that mountain side, perished in that fissure! However, the cold fact is that neither our talented physical anthropologist nor any other man knows any more about the number of men in any country during the Pleistocene than he does about the number of Pleistocene elands in North America or the number of chimpanzees that were living in Europe with the Piltdown man.

The writer wishes to correct two misstatements. In Science of April 12, 1918, on page 371 the statement is made that certain fossils had been found at Wilmington, N. C. Brunswick, Ga., was meant. In the paper in the *American Anthropologist,* Vol. XX., p. 20, it was stated that Dr. Samuel Aughey furnished no details regarding the finding of an arrowhead near Sioux City, Iowa. Details were furnished and the arrowhead was figured.

Oliver P. Hay

Washington, D. C.,
October 11, 1918

SCIENTIFIC EVENTS

RECENT ACQUISITIONS FOR THE LIBRARY AND MAP COLLECTION OF THE ROYAL GEOGRAPHIC SOCIETY

The *Geographical Journal* reports that the liberality of Mr. Yates Thompson has once more brought some interesting additions to the society's collections. One is an illuminated chart, on parchment, of the coasts of the Mediterranean and western Europe, by a member of the well-known family of Oliva (originally Olives), who migrated from Majorca to Italy and worked as chart-makers during the greater part of the sixteen and seventeenth centuries. Their charts were the lineal successors of the old Portolan charts which so long served the practical needs of seamen, and which continued to be made, long after printed maps and charts had come into general use, as an ornate furniture for the libraries of the wealthy. The present specimen is in excellent condition, and bears the inscription "Placitus Caloirus et Oliva fecit in nobili urbe Messane, año 1617." It is remarkable for the *duplication,* with but slight variation, of the portion concerned with the Mediterranean coasts, while the Atlantic coasts are shown independently, though with no dividing line, at the left-hand side of the chart. Another interesting gift from the same donor is that of copies, dated 1556 and 1558, of the map of the British Isles, engraved in Italy after the original by George Lily, whose monogram appears on the earliest known specimen, of 1546, preserved in the British Museum. This map was the first printed map of the islands to give a fairly correct representation of the outline of Scotland, though the means by which such an approximation was attained is unknown. It was revised at various dates, and included in Lafreri's famous Atlas. The two versions now presented are almost exactly alike in substance, but the later of the two was entirely re-engraved on a somewhat larger scale, with slightly more ornamentation, and intended to be read with the west, not the north, at the top. In view of the question sometimes raised whether the name "Britain" includes Ireland, it may be noted that in these maps it is distinctly reserved for the larger island only. Other acquisitions have been made at book sales, of which several during the summer were specially important from the point of view of geography. The seventh portion of the great Huth Library was disposed of early in July, and various early works of travel and geography fetched unusually high prices, justified, no doubt, by the exceptional condition of the copies offered. The society secured through Mr. H. N. Stevens, a copy of the rare small quarto Atlas of America by the French cartographer Nicholas Sanson. It is one of four similar volumes devoted to the four larger continents, of which the library already possessed those on Europe and Africa. These volumes consisted of both maps and descriptive text, and were among the earlier productions of their author, anticipating by some years the larger general atlases by which he is best known. Each ran

through several editions, the American volume first appearing in 1556, and being revised in 1657, 1662 and 1667 (?). The copy has a title-page dated 1662, but the maps all bear the date 1657. It may be noted that the volume contains an early mention, in the chapter on Paraguay, of the great Guayra falls on the Paraná river. Copies have also been secured of the first English edition (1708) of François Leguat's "New Voyage to the East Indies," containing a detailed account of his experiences in the islands of Rodriguez and Mauritius, with descriptions and quaint cuts of their remarkable fauna and flora; and of Le Huen's adaptation (with additions describing his own experiences) of Breydenbach's famous "Perigrinationes in Terram Sanctam." This copy is of the third edition, 1522. Lastly, a complete set has been acquired of the great French "Description de l'Egypte," based upon the work of the French scientific men sent to Egypt by Bonaparte at the time of his intervention in that country.

QUICKSILVER DEPOSITS IN THE PHOENIX MOUNTAINS, ARIZ.

THE present exceptional demand for quicksilver in the manufacture of fulminate gives the domestic deposits of this war metal particular interest. Deposits recently discovered in the southern part of the Phœnix Mountains, 10 miles northeast of Phœnix, Ariz., are described in a short paper prepared by F. C. Schrader, just published by the United States Geological Survey. The deposits are easy of access, and being near the rich agricultural region of Salt river valley are otherwise favorably situated for mining. They are being exploited on six or more properties or groups of claims, which lie in a belt, about 3 miles wide, that extends northeastward diagonally across the range.

The rocks in the region are metamorphosed sediments of pre-Cambrian age, chiefly schist, slate argillite, limestone and quartzite. They crop out in narrow parallel zones and dip steeply to the southeast. They are horizontally sheeted and are crosscut by faults, fractures and cleavage. The deposits are in the zones of schist, notably quartz schist and kyanite schist. They are lodelike deposits, some more than a mile long and in places 80 feet wide, which occur along zones of shearing or fracture that are parallel with the lamination of the schists.

The ore minerals are cinnabar and cinnabarite. They are found mostly along the planes of schistosity, forming ore bodies several inches wide and 3 or 4 feet long, but they also occur sporadically in quartz stringers and veinlets. A little native quicksilver has also been reported. Associated with the deposits are copper minerals, especially malachite, chalcicite, and chalcopyrite. The gangue minerals, the chief constituents of the stringers and veinlets, are quartz, calcite hematite, limonite, specularite, kyanite and tourmaline.

The deposits were probably formed by heated solutions or vapors which, ascending through the shear zones, penetrated the interstices of the rocks and deposited their mineral burden as veinlets and films by impregnation and replacement. They are provisionally referred to the Tertiary period, during which volcanism was general in the southwest. Tertiary volcanic rocks occur at several places in the surrounding region.

Although the deposits are but slightly developed, the deepest shaft being but 60 feet in depth, three of the properties yield workable ore that carries 3 per cent. or more of quicksilver. The persistence of the lodes and downward improvement of the ore in the shafts indicate that the ore extends to considerable depths, especially in the oxidized zone.

As the deposits are easily accessible, ore averaging as low as 1 per cent. in quicksilver can no doubt be profitably worked with the metal at its present market price. On one of the properties a retort furnace has been installed and a small amount of commercial quicksilver produced.

The paper describing the deposits, which is published as Bulletin 690-D, under the title "Quicksilver deposits of the Phœnix Mountains," may be obtained by applying to the

Director of the United States Geological Survey.

THE SELECTION OF PRESIDENTS OF THE AMERICAN CHEMICAL SOCIETY

The following report of the committee on election of President, and changes in the constitution, were unanimously adopted at the recent meeting of the American Chemical Society:

The committee appointed to consider a possible revision of the current procedure of the election of a president of the society begs leave to make the following report:

Your committee is of the opinion:

(*a*) That there is need for an increased interest on the part of the membership at large in the selection of presidents of the society, and (*b*) that there should be some procedure adopted which will ensure the presentation of four nominees to the electing body as provided for in the constitution.

After correspondence, consultation and discussion, the majority of your committee makes the following recommendations which they believe will greatly improve the situation, and which, they also believe, can be given a trial without involving changes in the constitution, which are undesirable in these times of stress, notably because of the clerical labor which they require.

These recommendations are:

(1) That the secretary be empowered to request each local section of the society to submit to him, not later than October 15, the name of some person from the membership at large of the society whom they consider suitable for nomination for the office of president of the society. It should be made clear that the selection is to be made from the entire society, and not necessarily from the membership of the Section making the suggestion.

(2) That the Secretary be empowered to send out, with the nominating ballots sent to the members of the society on November 1, as required by the constitution, the names thus suggested by the local sections, the list to be alphabetical and without indication of the section or sections from which any name may have been submitted. This list should be accompanied by a statement indicating that other nominations by individual members are in order, and that the list is suggestive only.

(3) That the secretary be requested to ascertain by telegraph from each member whose name is thus suggested by the local sections, and before the list is sent out, whether, in the event of nomination by the members at large, he will allow his name to be presented to the council as a nominee for the office of president.

(4) That the subsequent procedure be the same as at present.

Two members of your committee (Major Frankforter and Dr. Richardson) dissent from the foregoing recommendations. They favor a return to a procedure abandoned some years ago, under which nominations would be made by the council and submitted to the entire membership of the society for election. The majority of your committee has carefully considered this proposal, but is of the opinion that it is not advisable to revert to the older custom. They favor a trial of the procedure as outlined above before making changes in the constitution. They are of the opinion that this procedure will serve to increase the interest of members in the election of a president, and that it will prove satisfactory. It can be put into immediate operation and avoid constitutional changes at a time when they present unusual difficulties.

Your committee has reviewed the constitution and, while there are some clauses which might be modified in wording to some advantage, there appear to the majority of your committee to be no matters of serious import at this time. They recommend that no alterations be made at present.

Respectfully submitted,

H. P. Talbot,
M. T. Bogert,
by H. P. T.
B. F. Lovelace,
by H. P. T.

MEDICAL COMMISSION TO ECUADOR

To prepare for after-the-war commerce and make possible, by prevention of diseases such as yellow fever, a great expansion of trade between the United States and the west coast of South America, the Rockefeller Foundation sent, last summer, a commission to Ecuador. The three American members of this commission, which returned to Chicago early in October, are members of the medical school faculty of Northwestern University, Chicago, Illinois, Dean Arthur I. Kendall, who is a director of the Rockefeller Foundation for experimental work; Professor Charles A. Elliott, and Professor H. E. Redenbaugh. Dean Kendall for two years served under General Wm. C. Gorgas during the construction of the Panama Canal.

The commission left the United States in July and spent most of the time investigating conditions in the hospitals, pest houses and laboratories of the city of Guayaquil, which is the capital and principal city of Ecuador. Latin American papers received here from Guayaquil and other places show that a warm welcome was accorded the investigators who, in their words, were "putting into practise scientific methods for the purpose of invevstigating the parasite responsible for the yellow fever." The South Americans were also pleased with the prospect that the work of the commission in allaying this disease would prepare the way for the opening of commerce on a larger scale with the United States. At present, there is in preparation a complete report with recommendations of the commission. This will soon be issued by the Rockefeller Foundation and should prove of special interest, not only to scientific men, but to business men and others who are looking to after-the-war commercial expansion.

SCIENTIFIC NOTES AND NEWS

THE autumn meeting of the National Academy of Sciences will be held in Baltimore on Monday and Tuesday, November 18 and 19, 1918, at the Johns Hopkins University, Homewood. Scientific sessions will be held on both days. Luncheons will be served at the Johns Hopkins Club, where the meetings will also be held. The academy dinner will take place at the Maryland Club on Monday evening.

ON account of the epidemic of influenza the public meetings of the American Ornithologists' Union which were to have been held in New York, November 12 to 14, will be omitted. The regular meeting of the fellows and members for the election of officers and the transaction of other business will be held on Monday evening, November 11, at 8 P.M. at the American Museum of Natural History.

LIEUTENANT COLONEL W. C. SPRUANCE has been placed in charge of chemicals in the Ordnance Department.

PROFESSOR H. A. KENYON, of the college of engineering of the University of Michigan, was commissioned as captain during the month of August, and assigned to the executive division of the general staff.

DR. FRANK T. F. STEPHENSON, past president of the Detroit Section of the American Chemical Society, has been commissioned captain in the Medical Corps.

PROFESSOR I. W. BAILEY, of the Bussey Institute for Research in Applied Biology, has been given leave of absence by Harvard University and has accepted a position in the materials engineering department, Bureau of Aircraft Production, Dayton, Ohio.

PROFESSOR W. R. DODSON, dean of the college of agriculture and director of experiment stations of the Louisiana State University, is working with the Food Administration in the division of agricultural relations.

FRANCIS D. FARRELL, dean in the Kansas State Agricultural College, has been appointed by Governor Arthur Capper to membership in the Kansas council of defense. Dean Farrell has also been made a member of the committee on agricultural production of this body.

MR. PHILIP G. WRIGHTSMAN, formerly instructor in chemistry at Iowa State College, is now in the Chemical Warfare Service working on toxic gases in the Research Division, American University, Washington, D. C.

Dr. Robert S. McEwen, on leave of absence from the department of zoology in Oberlin College is in government service at the Army Medical School at Washington, as instructor in parasitology.

Professor M. F. Coolbough, of the department of chemistry, Colorado School of Mines, is in Washington on leave of absence and is engaged in war work at the Bureau of Mines.

Dr. H. M. Loomis, formerly of the Bureau of Chemistry, Department of Agriculture, has been made chief inspector of the sardine canneries of Maine and Massachusetts, for the Food Administration.

Mr. H. M. Freeburn has resigned as assistant engineer of the Pennsylvania State Department of Health to become associate with the engineering staff of Wallace and Tiernan Co., New York City, manufacturers of chlorine control apparatus and sanitary engineering specialties.

Professor R. E. Caldwell has left his work as chief of the department of dairy husbandry at Purdue University, Lafayette, Indiana, to take charge of the research and educational department recently organized by the Blatchford Calf Meal Company of Waukegan, Illinois. His work will consist mainly in the conducting of feeding experiments in an effort to discover the ingredients necessary to produce the best milk substitute feed for immature animals.

The last number of the *Journal of Industrial Chemistry* among its personal notes records the following changes from educational to industrial work: Professor Benton Dales, formerly head of the chemistry department of the University of Nebraska, research chemist for the B. F. Goodrich Co., Akron, Ohio; Mr. F. W. Bruckmiller, formerly assistant professor of chemistry at the University of Kansas, chemist for the Standard Oil Co. (Indiana), at Sugar Creek Mo.; Professor J. B. Rather, head of the department of agricultural chemistry in the University of Arkansas, chemist with the Standard Oil Company, New York; Dr. M. L. Crossley, acting head of the department of chemistry at Wesleyan University, chief chemist for the Calco Chemical Co., Bound Brook, N. J.; Miss Jessie E. Minor, associate professor of chemistry at Goucher College, chief chemist for the Hammerschlag Paper Mills, Garfield, N. J.; Mr. Carleton B. Edwards, head of the chemistry department at Guilford College, chemical engineer in smokeless powder with E. I. de Pont de Nemours and Co. Similar changes are reported in Science almost every week. It would be in the interest of higher education to record the salaries received in the educational and in the industrial positions, and the time and facilities allowed for research work.

"Chemistry and the war" was the subject of an illustrated lecture delivered to the students at Lafayette College on October 23 by Colonel Wilder D. Bancroft, professor of physical chemistry at Cornell University, now of the Chemical Gas Warfare Service.

The Ingleby Lectures for 1918 before the University of Birmingham were given by Dr. Peter Thompson, professor of anatomy in the university, on October 17 and 24. The subject was "Some problems in embryology."

The Geographical Association has founded a memorial lectureship in memory of the late Professor Herbertson, and M. Schrader delivered the first lecture in Oxford on November 5. M. Schrader is well known by his *Atlas de géographie historique,* and his continuation of the *Atlas universelle* of Vivien de S. Martin, and for his more recent work in the re-afforestation of French mountain slopes.

The Prince of Wales has accepted the position of patron of the Ramsay Memorial Fund, founded in November, 1916, to raise £100,000 as a memorial to the late Sir William Ramsay. The committee has already raised £37,000, and subscriptions from oversea committees will probably bring the total to £50,000. It is proposed to raise the remaining £50,000 by a million shilling fund, now opened with a donation of 1,000 shillings from the Prince of Wales. Already over 10,500 shillings have been privately subscribed. The fund will provide Ramsay Research Fellowships and a Ramsay Me-

morial Laboratory of Engineering Chemistry in connection with University College, London. Donations from one shilling upwards should be sent to the honorable treasurer, Lord Glenconner, at University College, London, W.C.1.

THE faculty of the medical school of the University of Minnesota, Minneapolis, has adopted a memorial to its former dean, Frank Fairchild Wesbrook, M.A., C.N., M.D., president of the University of British Columbia, bearing testimony to his qualities as a scientific man, as a leader and administrative officer, and as a councillor and friend.

LIEUTENANT ADMONT HALSEY CLARK, M. C., U. S. Army, assistant professor of pathology in Johns Hopkins University; resident pathologist to Johns Hopkins Hospital; who had done brilliant experimental work in pneumonia and diabetes, died in Johns Hopkins Hospital on October 13, from pneumonia, following influenza, aged thirty years.

MAJOR ALFRED REGINALD ALLEN, instructor in neurology in the University of Pennsylvania, has been killed in France, aged forty-two years. Major Allen was a leading neurologist but preferred to enter active infantry service.

LIEUTENANT GILBERT DOOLITTLE, U. S. Engineers, son of Dr. Charles L. Doolittle, professor emeritus of astronomy in the University of Pennsylvania, was killed in action on September 25, aged forty-five years.

CHARLES S. CAVERLY, M.D., professor of hygiene in the University of Vermont College of Medicine, and president of the State board of Health since 1891, died, on October 16, in Rutland, Vt., Dr. Caverly was widely known as a specialist in infantile paralysis.

DR. ERNEST G. GENOUD, a specialist on fermentation processes and a member of the staff of A. D. Little, Inc., died at his home in Dorchester, Mass., on October 12, of pneumonia following influenza, aged thirty-eight years.

WILLARD E. CASE, known for his contributions to electrical science, died at Auburn, N. Y., on October 30, of Spanish influenza, at the age of sixty-one years.

WILLIAM MAIN, formerly professor of chemistry in the University of South Carolina and one of the pioneers of the electrical industry, died at his home in Piermont, N. Y., on October 18, in his seventy-fourth year.

HOWARD SHELDON COE, agronomist in the United States Department of Agriculture, died from pneumonia following influenza at Beaumont, Texas, early on the morning of October 25, while absent from Washington on a field trip. Mr. Coe was born at Orrville, Ohio, in 1888, and graduated from the Iowa State College of Agriculture, in which institution he was for a time assistant instructor of botany. In 1913 he was appointed consulting botanist and plant pathologist at the South Dakota Agricultural Experiment Station, which position he held until he entered the service of the United States Department of Agriculture, in July, 1914. He was the author of numerous botanical and agricultural papers.

DR. WILLIAM G. MALLORY, associate professor of physics, in Oberlin College, died of pneumonia on October 19. He received the degree of A.B., from Oberlin in 1905, followed by the master's degree two years later. During this time he was serving as a laboratory assistant. From 1907 to 1909 he was instructor in physics at Oberlin. Then followed a year of study at Cornell University, after which he accepted the professorship of physics and astronomy at Randolph-Macon College. During the winter of 1912–13 Dr. Mallory was a fellow in physics at the University of Chicago, and the next year became acting head of the physics department at Miami University. In 1914 he was called to Cornell as instructor in physics, holding this position until spring of the present year. He received the degree of doctor of philosophy from Cornell in June, 1918, and was chosen to aid in the Carnegie Research work at Ithaca. He went to Oberlin in September, taking the work of Dr. Samuel R. Williams, head of the Oberlin de-

partment of physics, who is at present engaged in war work for the Council of National Defense.

Brigadier-General Edgar William Cox, head of the Intelligence Staff of the British Army in France, was accidentally drowned on August 26, aged thirty-six years. His advancement in the army had been rapid. To scientific men he was known for topographical surveys and publications.

Sixteen platinum dishes and crucibles were stolen from the Kentucky Agricultural Experiment Station, Lexington, Kentucky, during the week following October 17. The police department of Lexington offers $100 for their recovery or for information leading to the conviction of the thief. The urgent need for this material at this time deserves earnest effort and cooperation in its recovery.

The Field Museum of Natural History in Grant Park, Chicago, which is nearing completion, and has cost $7,000,000, has been turned over to the government for use as a hospital. The interior will be rearranged so that 4,300 patients can be accommodated and a number of smaller buildings will be erected around the main structure for the accommodation of 1,000 nurses. The museum building covers six acres and has more than twenty-five acres floor space.

Over 30,000 persons paid for admission to the British Scientific Products Exhibition at King's College. Professor R. A. Gregory, chairman of the organizing committee, states that it is proposed to arrange for an annual exhibition of British science and invention.

Alfred I. du Pont, the owner of the Grand Central Palace, N. Y., has announced that, notwithstanding the fact that the government is to take over the building for the period of the war as a base hospital for the Army and Navy, he intends to proceed with his plans for creating there a center for world commerce after the war in an Allied Industries Corporation.

The Sibley Journal of Engineering, published at Cornell University, announces that with the November issue it will cease to appear until the resumption of normal university conditions.

We learn from *The Auk* that at the annual meeting of the British Ornithologists' Union, Dr. W. Eagle Clarke was elected president to succeed Colonel R. Wardlaw Ramsey who had served for the last five years. The membership of the Union stands as follows: Ordinary 423, Extraordinary 1, Honorary 8, Honorary Lady (the only lady members) 8, Colonial 9 and Foreign 19. The Honorary and Foreign (equivalent to the Corresponding Class of the A. O. U.) it will be noticed are much more restricted than in the A. O. U. The American ornithologists represented in these classes are as follows: Honorary, Dr. J. A. Allen, Dr. Frank M. Chapman, Dr. Harry C. Oberholser, Dr. Chas. W. Richmond and Mr. Robert Ridgway. Foreign, Dr. Leonhard Stejneger and Dr. Witmer Stone.

UNIVERSITY AND EDUCATIONAL NEWS

Additions to the teaching staff of the college of medicine, University of Cincinnati, are Professor Dennis E. Jackson, of Washington University, Professor Albert Prescott Mathews, of the University of Chicago, and Dr. Shiro Tashiro, of the University of Chicago. They have been appointed, respectively, to the chairs of pharmacology, biochemistry and physiological chemistry.

Dean Mortimer E. Cooley, of the department of engineering of the University of Michigan, has been made regional director in the Student Army Training Corps for the district comprising Wisconsin, Michigan and Indiana.

Professor J. W. Young, of Dartmouth College, has accepted the position of director of the mathematical instruction given under the auspices of the Y. M. C. A., to serve for three months, beginning November 1.

Dr. Earl F. Farnau, assistant professor of chemistry at New York University, has been appointed associate professor of organic chemistry at the University of Cincinnati.

DR. ARTHUR M. PARDEE, professor of chemistry at Tarkio College, has been appointed professor of chemistry at Washington and Jefferson College, Washington, Pa.

THE following appointments have been made in the engineering departments at Lafayette College: H. S. Rogers, of the faculty of the University of Washington, has been appointed assistant professor of civil engineering; Ralph S. Wilbur, a graduate of Tufts College and a former member of the faculty at Iowa State University, more recently employed by the Ford Instrument Company, has been appointed assistant professor of mechanical engineering; H. M. Spandau, of Whitman College, Washington, has been made assistant professor in engineering drawing. Charles A. Aey, professor in physics at Allegheny College last year, has been appointed instructor in physics; Landon A. Sarver, a private in the Chemical Gas Warfare Service, and former instructor in chemistry at the Johns Hopkins University, has been appointed instructor in the department of chemistry; Walter G. Kleinspehn, a graduate of Lafayette, '18, is also an instructor in chemistry.

DR. H. H. HODGSON has been appointed head of the department of coal-tar color chemistry instituted two years ago at the Huddersfield Technical College to provide specialized chemical teaching with research facilities for the sudden influx of chemists caused by the great development of the color industry in Huddersfield. Dr. Hodgson has for nearly three years been chief chemist to one of the largest firms of chemical manufacturers in England. He was previously head of the chemical department at the Northern Polytechnic Institute in London.

DISCUSSION AND CORRESPONDENCE

SHALL WRITERS UPON THE BIOLOGICAL SCIENCES AGREE TO IGNORE SYSTEMATIC PAPERS PUBLISHED IN THE GERMAN LANGUAGE SINCE 1914?

IN a footnote appended to one of his latest papers, which appeared in the *Proceedings of the Zoological Society of London*, April, 1918, p. 55, Sir George F. Hampson says: "No quotations from German authors published since 1914 are included. *'Hostes humani generis.'*"

In the columns of *Nature*, issued September 5, 1918, Lord Walsingham, using the above footnote as his text, suggests that "for the next twenty years, at least, all Germans will be relegated to the category of persons with whom honest men will decline to have any dealings," and proposes that scientific men throughout the world shall by common consent agree to ignore all papers published in the German language, not as a measure of "vengeance," but as a measure of "justice." He adds that the truly scientific German, whose labors are worthy of consideration, and who is actuated by sincere love of truth, ought to feel it no hardship to publish the results of his researches in English or French periodicals, especially in the view of the fact that educated Germans are all more or less familiar with these languages.

In justification of his position Lord Walsingham points out the fact, which he, as one of the foremost entomologists of the world, is better able to aver than those less erudite, that in the "Catalogue of the Palæarctic Lepidoptera," published in 1871 by Staudinger & Wocke, "precedence is improperly but deliberately assigned to German names in preference to earlier ones given by French authors"; and he also recalls the persistent manner in which the representatives of German scientific societies at the meeting of the International Zoological Congress at Monaco in 1913 attempted to dominate the discussions, and to insist that German usage in matters of nomenclature should receive universal sanction "to the exclusion of all attempts to trace out the literary history of each species and to preserve for it the name bestowed by the first author who described or figured it." The writer of these lines, who was a member of the First International Entomological Congress which met in Brussels in 1910, recalls quite vividly that the same pushing tendencies and arrogance were also displayed on that occasion by certain of the German delegates.

To the searcher for truth for truth's sake it has been for many years both amusing and irritating to observe the manner in which even in scientific circles Teutonic megalomania has been growing by leaps and bounds. German conceit, originally engendered by the easy victory over France in the Franco-Prussian War, and fostered by subsequent German commercial success and prosperity, spread rapidly from political and military circles into the ranks of scientific investigators. A gullible world, easily duped, accepted the pretensions of these alleged "supermen," not only in the fields of war and mercantile industry, but also in the fields of science. The uninformed and unreflecting attributed to German *sitzfleisch* the honors which belong to *esprit*, mistaking assiduity for genius. Perhaps the most wofully deceived person was the German himself, who, contemplating the results of his compilatory labors, exclaimed after the manner of little Jack Horner "What a Big Boy am I!"

The writer of this note is to a certain extent in sympathy with his two learned friends, Hampson and Walsingham, and at future international congresses is prepared to vote heartily, should they make the motion, for the exclusion of the "Berliner Geck" from gatherings in which said "Geck" may rise and attempt to air himself and his opinions. He has, however, a conviction that in future assemblages of this sort there will be less manifestation of the Prussian spirit than there has been in the recent past. Events are so shaping themselves that our friends, "the supermen," will be inclined to take a position more nearly in accord with the facts of the universe in which they and we live.

The writer, however, can not unqualifiedly give in his adhesion to the proposal to ignore the work of Teuton naturalists unless published in English or French. While it is true that the value of the work done by Germans in many fields has been ridiculously overestimated, nevertheless there is a certain body of men in Germany—unless they have been shot off in recent battles—whose work is worthy of respect. These men naturally write in German. It is their mother tongue, and there are, or used to be, a host of periodicals open to them. If by chance some of them should erect a genus, or describe a species having validity, according to the inexorable "law of priority" the names given by them will have to stand in the future literature of science, and it will not mend matters to pass resolutions declaring that only papers published in English and French shall be taken into consideration by systematic workers. This war is not going to last forever. We hope that Prussian militarism and despotism will vanish from the world, as other nightmares have vanished in the past. We trust that a full atonement for political and military crimes will be exacted. We expect that sanity will return after a while to German crania, and that megacephalic symptoms (they call the disease "big-head" in Kentucky) will abate, and that peace will return to this war-worn world. When that time comes, we will have, to quote Lord Walsingham himself, "to trace out the literary history of each species, and to preserve for it the name bestowed by the first author who described or figured it." It will then not matter whether he was English, French, American, Japanese, or German. It will be, just as it has been in the past, a matter of purely historico-scientific interest. English men of science recognize to-day the scientific names given by Frenchmen who applied them at a time when England was at war with France. English men of science and American men of science will do the same thing in the case of names given by Germans with whose despotic and autocratic powers we are now at war.

The writer loathes despotism and conceit and ignorance and cruelty. The loathing he feels for these things, however, does not blind him to the eternal verities. The essence of science is truth. He can not conceive how scientific truth can be advanced by a resolution that its utterance shall be confined to the English and French languages, though he prefers these languages to German and Choctaw. The adoption of the proposal made by Lord Walsingham would conduce to that state of affairs which he reprobates in the case of Staudinger & Wocke's "Catalogue." Science

in fact is international and universal. There is not an English entomology, nor a French paleontology, any more than there exists a Roman Catholic algebra or a Presbyterian geometry. We certainly have provocation, but the test of our scientific fitness is found in our ability to avoid the mistake of attempting to beat the Prussian by Prussianizing ourselves.

W. J. HOLLAND

CARNEGIE INSTITUTE,
October 18, 1918

THE FOUNDATIONS OF MECHANICS

MR. PAUL J. FOX, in his comments[1] on our article of August 2d seems to us to be mistaken in two particulars. Surely to *identify* a force, so that the same force can be reproduced at will and caused to act at one time on one body and at another time on another body, is not the same thing as to *measure* the force. If we are to compare the accelerations of different bodies due to a given force, some basis of identification of the force is necessary; for example, it may be the force which will produce a certain stretch of a given spring. To identify a force, or a temperature, is not the same thing, by any means, as to measure the force or temperature.

If Mr. Fox will read our article carefully he will see that we do not even imply that the quantitative idea of mass is necessary for either the identification of measurement of force. Every physicist knows, and knew long before Perrin's time, that a rigorous quantitative definition of force is possible in terms of stretched springs without assuming Hooke's law. But no one, perhaps, has ever measured a force in this way, and by *measuring* we do not refer to any kind of thinking nor to any mathematical operation, much as we love both of these categories; we mean a laboratory operation (troublesome though such things be), and especially we mean a laboratory operation which gives an invariant result irrespective of special properties of particular substances and independently of time and place.

Perhaps our deeper source of confusion may be, as Mr. Fox says, "in not making a distinction between mechanics as a 'doctrinal function' and as an experimental science." But we do not believe it; and for Mr. Fox to borrow the term in mild ostentation from Bertrand Russell leaves us unimpressed. Surely it is no mark of fixity of ideas on our part not to take Bertrand Russell over-seriously even in doctrinal mechanics and to always attend carefully to what has been said by Newton and Thomson and Tait, and Larmor.

Our mathematicians are rightly interested in the invariance of all kinds of functions with respect to a wide variety of transformations, and the physicist has seen many remarkable applications of this sort of invariance, the most remarkable of all being the recent generalized form of the principle of relativity; but the mathematician does not seem to understand that there is a kind of mathematics involved in the always more or less idealized operations and transformations of the laboratory with their amazing groups of invariances. Indeed, when we read such passages as the following from Mr. Fox's communication, fear that our mathematicians may never be able to fathom the deeper phases even of doctrinal physics—for the whole of the logical structure of the physical science is, let us borrow the phrase from Bertrand Russell, doctrinal.

"Thus it is clear that the units we have in the Bureau of Standards need not be the same as the undefined elements in the doctrinal function. We do not need even to imagine that Bureau keeping standard springs, rubber bands, strong armed men, etc., any more than it would keep a standard point (!) instead of a standard meter, for Veblen's system of geometry. Any equation may be made use of to measure any quantity which it contains." Mr. Fox, further on, quotes Frederic Soddy's statement that "the conception of force and its psendo physical reality undoubtedly delayed for centuries the recognition of the law of the conservation of energy, etc.," and states that there seems to a certain mysticism in Soddy's contention. Not at all. Let Mr. Fox read and digest the remarkable appendix on The Scope of Mechanical Explanations in Larmor's

[1] SCIENCE, October 4, 1918.

"Æther and Matter," or, an extremely simple exposition of some of the simpler of Larmor's ideas on pages 322–325 of Franklin and MacNutt's "General Physics." Others besides Bertrand Russell have recognized the Doctrinal Function.

W. S. Franklin
Barry MacNutt

SCIENTIFIC BOOKS

The Origin and Evolution of Life, on the Theory of the Action, Reaction and Interaction of Energy. By Henry Fairfield Osborn. New York, Charles Scribner's Sons. 1918. Pp. xxxi + 322. Price $3.00.

Professor Osborn's Hale Lectures, reprinted in an enlarged form in this attractive volume, raise anew the question: are the factors of organic evolution *centripetal,* consisting in the direct "moulding" action of environmental agencies upon the organism? or are they *centrifugal,* the expression of the innate formative and other physiological activities of the germ itself, operating under conditions largely independent of the immediate environment? He perceives, however, that the question can not rightly be put as one of alternatives, but that factors of both kinds necessarily enter. Organism and environment are in continual interaction; what affects the one inevitably affects the other; there is always an interchange of material and energies, constituting a more or less stable equilibrium in a well adapted organism. Organic evolution has had a complex and diversified outcome because the conditions are complex; adaptation, both of structure and activity, has developed as a distinctive feature of living beings because it is an essential condition of the vital equilibrium, *i. e.,* of survival. The factors of evolution are thus various and are classified by the author under four chief heads: (1) action of the inorganic environment, (2) of the organism itself, (3) of the germinal substance of the organism ("heredity chromatin"), and (4) of the living environment, *i. e.,* influence exerted by other living organisms, *e. g.,* competitors. Each of these "four complexes of energy" is to be conceived as itself evolving, partly independently, partly in relation with the others; and the evolution of living organisms has taken place under this fourfold or "tetrakinetic" influence. While the environment, inorganic and organic, *controls* the evolutionary process —permitting the survival only of those organisms which are adapted—the process itself is largely conditioned from *within, i. e.,* by the internal or constitutional peculiarities of the germinal substance, which throughout the book is identified with the chromatin of the germ-cells. Evolution is creative, *i. e.,* novelty perpetually arises, although at varying rates and in varying degree in the different lines of evolutionary descent; but the precise causes and conditions of its appearance remain to be determined; to explain the origin of new varieties a more complete knowledge of the physiology of the germinal substance is required. Paleontological research indicates that variations in the germ can be referred only partly, if at all, to the direct action of the environment upon the entire organism; thus rapid evolution may take place during periods in which there is little geological evidence of extensive natural change, and conversely many forms of life remain stable through the changes and chances of whole geological epochs (p. 137). Paleontology finds one evolutionary line, *e. g.,* reptiles, exhibiting active diversification at a certain period of its history, while at a later periods it relapses into conservatism at the very time when another line, the mammals, develops extraordinary creative activity (p. 231). Evolution, as observed in the paleontological succession of animal forms, often appears to progress in definite directions toward adaptive ends (pp. 146–240),—a fact which would seem to indicate a guidance by natural selection; but selection, while an important condition, can not be regarded as in itself an active agent. Repeated instances occur of characters, at first apparently non-adaptive, continuing to evolve until they become important assets in the struggle for existence. The author inclines to regard the essential agency in evolution as an apparently spontaneous germinal variability. directed along certain definite lines; this "internal

evolutionary impulse "he conceives as mainly determined by the innate properties of the germinal substance, *i. e.*, by "chromatin potentiality" (p. 231). This potentiality determines the rate of appearance and the character of new variations independently of natural selection; for example, paleontology shows that the slowly breeding race of elephants, on which selection might be expected to act slowly, have evolved much more rapidly than the frequently breeding rodents (p. 271). Everything depends upon the "invisible predispositions and tendencies in the ancestral heredity chromatin" (p. 242). There is, however, no evidence in paleontology of an internal extraphysical directive principle or entelechy; on the other hand, environmental conditions appear to exert a direct modifying influence, not attributable to selection, upon the evolving organism, but the nature of this influence remains obscure (pp. 243-244). That the germinal material possesses a power of "adaptive response" to the environment is indicated (*e. g.*,) by the evolution of teeth (p. 257).

In general, therefore, the author refers the evolution of the various metazoön stocks primarily to germinal variations, *i. e.*, more specifically, to variations of an orthogenetic or definitely directed kind in the "heredity chromatin." The evolution of visible bodily form and function is to be regarded as essentially the external sign and symbol of the invisible evolution of the heredity chromatin (p. 151). This "chromatin evolution" has its distinctive peculiarities; it is not "experimental" or hap-hazard but tends to be continuous in one direction toward adaptive ends (p. 146); evolutionary progress is thus not dependent either upon mutations or upon fortuitous variations which are held to a definite course only through the agency of natural selection. In a certain sense the author supports the Weismannian conception that the evolutionary factors act primarily upon the "germ-plasm," rather than upon the "soma"; he recognizes, however, that somatic modifications may secondarily influence the germ; and he appears to favor a kind of qualified Lamarckianism (p. 244); he suggests that possibly bodily changes may influence the germ through the intermediary of hormones (pp. 278 *seq.*). He insists, however, that the factors determining germinal evolution are still for the most part unknown (*cf.* pp. 23, 151).

The problem of the causes of germinal variation is essentially a physiological one. Everywhere in the book the author emphasizes the difference between the somatic and the germinal material, and it seems to the reviewer that this distinction is too sharply drawn. Certainly it can not be maintained in the case of the lowest organisms, *e. g.*, the bacteria or the ultramicroscopic forms of life, in which nevertheless heredity and variation are as truly manifested as in the highest. Such forms multiply or proliferate in a manner which is specific or true to type, but which may be influenced in definite directions by changes (*e. g.*, chemical) in the surroundings; and the same is undoubtedly true of all growing or developing regions in multicellular organisms, including the special germinal material (egg-cell and embryo) at the different stages of its development. Any form of organic growth implies the property of incorporating and assimilating, *i. e.*, transforming specifically, food and other materials taken from the surroundings; this property constitutes in fact the essential or distinctive feature of vital activity; it is common to all forms of living matter and heredity is one of its expressions. Hence the germ-cell can not be regarded as fundamentally different in its physiological constitution and properties from other cells or tissues of the organism. It is true that in higher animals the fertilized egg-cell has special powers of development not normally exhibited by other regions after isolation; but in many lower forms almost any detached portion of sufficient size may act as a germ, *i. e.*, may proliferate under favorable conditions and give rise to a complete organism. The appearance of a sharp distinction between soma and germ in higher organisms is itself a product of evolution; it represents a differentiation which does not exist in the lowest forms of life. Weismann's distinction is based upon the fact that

the germ in multicellular organisms is less readily influenced by environmental influences than the soma; profound somatic modifications may leave the germ-plasm apparently unaffected. There is, however, nothing surprising in this when it is considered that the undeveloped germ forms in most cases only a small and inaccessible part of the total organism; it is usually not subjected to external influences until it separates from the parent and begins its own independent development. But after this has happened environmental conditions may affect the egg and developing embryo just as they affect the adult, and the normal course of development may then be experimentally modified; *e. g.*, cyclopia may be produced in fish embryos, etc. No one can say at what time the protoplasm of the developing germ, whether in the one-celled or many-celled stage, ceases to be germ-plasm and becomes somatoplasm. Just as the rigid distinction between germ and soma can not be maintained, so it is doubtful if the "hereditary material" can be identified with any special single structures or cell-constituents, such as the chromatin. A universal peculiarity of the cellular type of organization appears to be that the nucleus, which always contains chromatin among other constituents, is indispensable to the continued normal physiological activities of the cell, including those specific synthetic processes of which growth and heredity are the most evident expressions. But to regard protoplasm (somatoplasm) as the *expression* and chromatin as the *seat* of heredity (p. 93) does not seem justifiable on physiological grounds. In the specific constructive processes which determine the course of development the physiological activity of the *entire* cell is concerned. To say this, however, is not to deny that there may be a functional differentiation, corresponding to the chemical and structural differentiation, among the various cell-constituents; and that a special significance in relation to the specific syntheses involved in development may attach to the nucleoproteins of the cell-nuclei, *i. e.*, to the chromatin. It is more consistent with modern physiology to conceive of chromatin as an especially active or constant participant in cell-metabolism, with some such special rôle as this, rather than as primarily a reservoir of hereditary determinants.

The consideration of organic evolution leads inevitably to a consideration of the physico-chemical nature of living matter and to speculations regarding its possible mode of origin from non-living matter. In Part I. the author discusses briefly some of the supposed steps in this evolution. He points out that the process must have been prolonged and complex. A prerequisite for the appearance of life was the production of the vital energy-yielding compounds, probably by photosynthesis, as well as of other compounds of colloidal character forming the structural substratum required for the metabolic reactions of protoplasm. To produce a regulated self-maintaining system of this kind, capable of indefinite growth, probably required ages of evolution. The rôle of electrolytes in living matter, and the necessity for special chemical compounds (catalysers, hormones) to control and coordinate the chemical processes of the primitive protoplasm, are among the matters especially discussed in this section. Interesting geological evidence is presented indicating the existence of an abundant unicellular flora and fauna (*e. g.*, calcareous bacteria) at extremely remote periods. This part of the book is highly suggestive, but less complete and authoritative than Part II.

Many striking observations and generalizations are scattered throughout the whole book and a masterly survey is given of the paleontological succession of animal forms. The illustrations are especially interesting, particularly the reproductions of Knight's landscapes, at once imaginative and scientifically exact, showing the prehistoric monsters in their native surroundings.

Ralph S. Lillie

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SPECIAL ARTICLES

NOTE ON A SIMPLE DEVICE FOR ILLUSTRATING MOLECULAR MOTION

In experimenting with mercury heated in an evacuated glass vessel, I observed that fine

particles of solid matter on the surface of the mercury were carried away by the evaporating mercury and moved about in the vessel in a very chaotic manner similar to the movement of molecules as postulated in the kinetic theory of gases and vapors. The stream of vapor which carried with it the particles was condensed upon the walls of the vessel and dropped back into the pool in the bottom of the tube.

A simple tube for illustrating the phenomenon is shown in the figure. The tube is about ten inches long and one inch in diameter and contains a small pool of mercury. A small quantity of finely crushed material, such as colored glass or carbon is placed upon the surface of the mercury to form a layer two or

three millimeters deep. Blue glass crushed in a mortar to give pieces about one half to one millimeter in size is found to be very satisfactory since particles of this size are easily visible. Particles of granular carbon or any other light material will do equally well provided that it does not amalgamate with the mercury. The tube is then evacuated and sealed from the pump in the usual manner. The degree of vacuum is not essential provided that it suffices to prevent oxidation of the mercury when the latter is heated, and thus to prevent the mercury from becoming sticky and adhering to the particles. The tubes experimented with were evacuated to a pressure of a few thousandths of a millimeter.

A gradual increase in the temperature of the mercury brought about by holding it over a Bunsen flame shows the following interesting phenomena: At a low temperature the particles begin to move about on the mercury surface. This movement of the particles gives the surface formed by them the appearance of a liquid agitated by convection currents. In this condition the particles have left the mercury surface and are moving about among each other close to the mercury in a layer having a rather well defined surface. A further slight increase in the temperature of the mercury causes some of the particles to leave the layer and to move about chaotically in the space above the surface similar to molecules which have left an evaporating liquid. At the same time the surface formed by the particles becomes indistinct and there is a gradual gradation of density of particles upward from the region just above the mercury. As the temperature continues to rise more of the particles leave the surface and also those which are moving in the space move to a greater height. Finally all of the particles leave the surface of the mercury and move about in the space colliding with each other and with the sides of the tube like the molecules of a gas.

The phenomena just described are more easily produced by first heating the mercury to the temperature at which all of the particles have left the surface and then observing them while the tube gradually cools; the above-described processes then occurring in the reverse order and simulating a condensing vapor. Because of the vacuum in the tube the temperature which is necessary to cause all of the particles to leave the surface is not sufficient to make the top of the tube too warm to hold in the hand. In order to make the particles more easily visible it is desirable to provide a white background by painting or frosting one side of the tube.

The device affords a simple means of illustrating the chaotic movement of a large number of small particles similar to the motion of molecules in gases and vapors. The similarity is especially instructive when compared with the evaporation of a liquid since the effect of the evaporating mercury upon the particles leaving its surface is similar to the actual motion of vapor molecules which leave a liquid.

The phenomenon can be projected upon a screen and the particles and their movement greatly magnified, so that the device may be used for lecture demonstration of the kinetic theory.

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ABNORMALITIES IN THE CHICK EMBRYO[1]

For the past five years the writer has had under her supervision the preparation of the vast amount of material used for large embryology classes. On account of the possibly controlled conditions under which it could be obtained, the chick was extensively used. Hundreds of these embryos have been examined. Seldom were the eggs incubated for a longer period than three days. For the first two years the pressure to secure material was so great than only the normal embryos of the right degree of development were saved. It was noticed that a large per cent. of the fertile eggs did not give embryos which were satisfactory for class use. The obtaining of an extremely abnormal embryo and two embryos on one blastoderm in a single incubation lead to the saving of all of the specimens. Since that time, over two hundred abnormal ones have been collected.

The abnormalities seemed to occur more in the central nervous system than elsewhere. Two regions were particularly affected, the brain and the neural tube in the region of the last two or three mesoblastic somites and the beginning of the segmental plate. However, the abnormalities did not occur in both of these regions in the same embryo. In embryos obtained from eggs incubated forty-eight hours the abnormality of the neural tube extended over a length of between one eighth and one fourth of a millimeter. The neural tube here was either solid without a central canal or the central canal was extremely small, or there were from two to five canals. This could be recognized in the whole mount as apparent loops of one side of the neural plate, or as a thickened part of the entire tube. The most extreme case of the abnormality of the brain was a seventy-two-hour chick, in which the brain was only about one-fourth the normal size and the fore-, mid- and hind-brains appeared as a series of loops. Another example was a forty-eight-hour chick which had an optic vesicle less than one third the normal size. This optic vesicle was connected with the brain by a stalk more than twice the normal length.

During the past summer Miss Alsop, a graduate student, undertook some experiments upon the cause of these abnormalities. At the same time we were running some controls under normal conditions. She found that she could obtain a large per cent. of abnormalities, and, at will, could produce them either in the brain region or in the region of the tube. She hopes to have a detailed account of her experiments, along with drawings and a more extended description of these abnormalities, ready for publication in a short time.

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[1] Contribution from the Zoological Laboratory, Kansas State Agricultural College, No. 22.

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